GeoEngineers

MEMORANDUM

Redmond

TO: Mr. Bill Dettman, Baugh Construction

FROM: Jim Roth and Dan Mageau, GeoEngineers

DATE: August 21, 1996 (Revised)

FILE: 0120-213-27

SUBJECT: Dewatering plan for Oil/Water Separator Structures - North Boeing Field

INTRODUCTION AND BACKGROUND

This memorandum presents our recommendations for temporary dewatering during construction of four oil/water separator structures at North Boeing Field in Seattle, Washington. The oil/water separators will be located near Concourse A at the north of the end of North Boeing Field, east of East Marginal Way South. This memo supersedes our draft memo dated August 19, 1996 and includes comments by Baugh regarding the recommendations presented in the August 19 memo.

We understand that the precast concrete tanks will range in areal dimension from about 8 by 14 feet to about 14 by 20 feet and will be approximately 11 feet deep. The present plan is to install sheet piles around the perimeter of each tank location prior to excavation. The sheet pile wall will be larger than the tanks to allow 3 to 4 feet of space between the tank walls and the sheet pile wall. We anticipate that the sheet piles will extend to depths of approximately 25 to 30 feet below grade.

The primary issue that we address in this memorandum is the appropriate method or methods to dewater the excavations inside the sheet pile walls during construction. Other issues include dewatering of utilities and manholes during construction and support of the concrete separator tanks.

SOIL AND GROUND WATER CONDITIONS

Our interpretation of soil and ground water conditions at the site is based on four shallow borings completed by SECOR for a recent environmental study and several deep geotechnical borings that were completed by GeoEngineers to depths of approximately 60 feet at the Boeing North Duwamish Campus for other projects. The borings generally encountered loose to medium dense fine to medium sand and silty sand. A 3-to 5-foot-thick layer of medium stiff to stiff silt was encountered in several of the geotechnical borings at depths of 5 to 10 feet below the ground surface. Ground water was encountered in the borings at depths of 7 to 9 feet below the ground surface.

REA 85019430
BVL

TANK EXCAVATION DEWATERING RECOMMENDATIONS

Recommended dewatering methods and equipment for the four tank excavations are presented below. As discussed at our meeting with you on August 9, we have developed two dewatering plans, Plan A and Plan B, for the tank excavations. Plan A includes shallow sumps with pumps and a CDF (controlled density fill) seal at the base of excavation. Plan B is supplemental to Plan A and would be put into action in the event that Plan A does not adequately control ground water entering the tank

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excavations. Plan B involves using one or more deep wells to remove ground water and reduce hydrostatic pressure in the vicinity of the tank excavations.

PLAN A DEWATERING

Plan A assumes that tightly interlocking sheet piles will be driven to depths of approximately 25 to 30 feet below ground surface at each tank excavation. Based on our experience with similar projects in the area, two shallow sumps with small pumps installed at each end of the excavations should be adequate to dewater the 12 to 13 foot deep excavations that are planned. We recommend excavating to within one foot of the water table (6 to 8 feet below ground surface) before installing the sumps.

SUMP SPECIFICATIONS AND INSTALLATION

The sump excavations should extend to a depth of about 16 feet below ground surface in order to control ground water for a 12- to 13-foot-deep excavation. To eliminate costs associated with mobilizing a drill rig to the site, we recommend that Baugh attempt to install the sumps using an excavator. However, it may be necessary to use a drill rig for sump installation if caving sand prevents excavation to a 16-foot depth.

A 12-foot-long section of 18-inch-diameter blank pipe (PVC or smooth steel casing, no perforations, no plate at bottom) should be placed in the sump excavation upon completion of the sump excavation. Pea gravel should be used to backfill around the outside of the 18-inch pipe as soon as the pipe is in place. A 12-foot-long-section of 12-inch-diameter steel pipe (closed-ended) should then be placed (centered) inside the 18-inch pipe. The bottom 10 feet of the 12-inch pipe should be slotted to allow water to enter the pipe. The slot openings should be 0.030-inch wide and the slot rows should be 1/4 inch apart. We recommend purchasing the slotted pipe from a well screen supplier. Local supplier include Johnson Screens in Mill Creek (338-9694) and Mitchell, Lewis & Staver in Tacoma (922-1441). A steel plate should be welded to the bottom of the 12-inch pipe to prevent entry of silt and sand through the bottom of the pipe. A removable, temporary cap should be placed over the top of the 12-inch pipe during sump installation.

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A filter pack consisting of medium sand should be placed in the annulus between the 12-inch and 18-inch pipes. A commercial grade 10-20 filter sand can be purchased under several brand names including Colorado Silica Sand from United Pipe & Supply in Lynwood (745-5700). We recommend placing 1 to 2 feet of filter sand at a time in the pipe annulus and pulling up on the 18-inch pipe while holding the 12-inch pipe in place. The objective is to place a 3-inch-thick filter pack around the outside of the 12-inch slotted pipe while removing the 18-inch blank pipe from the sump excavation. The discharge authorization from king county dated july 29, 1996 states that "there shall be no visibly pronounced turbidity" associated with the water discharged to the sewer system. A properly installed filter pack will greatly reduce the turbidity (murkiness) of the water pumped from the excavations.

A sketch showing construction details for the sump described above is attached to this memorandum.

REA 85019431
BVL

ESTIMATED DEWATERING FLOW

Based on the soil and ground water conditions encountered in borings near the tank excavations, we estimate that long-term dewatering flow rates from each of the four shored excavations will range from approximately 10 to 50 gpm (gallons per minute). Flow rates may be greater than 10 to 50 gpm for the first several days of pumping while shallow ground water stored in the sand is removed by the sumps. Actual dewatering flows will depend on several factors including the tightness of the sheet piling joints and the soil conditions encountered during construction. Dewatering flow rates may decrease significantly if a low permeability silt layer is located below the base of the excavation and above the base of the sheet piles. Higher flow rates may occur if coarse-grained soils are encountered during construction. The discharge authorization letter from King County for this project states that the flow limit from May 1 through October 31 is 75,000 gpd (gallons per day). 75,000 gpd is equivalent to 52 gpm over a 24-hour period. We understand that Baugh has the potential for obtaining a higher discharge limit from King County in the event that the combined dewatering flows from the tank excavations exceeds 52 gpm. Your construction schedule indicates that dewatering of up to two oil/water separator excavations may occur simultaneously during some portions of the project. Therefore, it is possible, although unlikely, that more than 75,000 gpd may be pumped from excavations at this site.

Submersible electric pumps capable of pumping 10 to 30 gpm against 30 to 35 feet of total head should be installed in each sump. The sump pumps should be oil cooled so that they are capable of running dry without burning-out the motor. Four-inch diameter rigid PVC pipe or 4-inch flexible hose will be sufficient for piping water from the sump pumps to a water storage tank. The water storage tank should be equipped with a series of baffles to allow fine sediment to settle out prior to discharge to the sewer system. A Baker tank, or similar, can be used for this purpose. A 21,000-gallon tank will provide a residence time of about seven hours for water pumped at a rate of 50 gpm.

FILL PLACEMENT

We recommend placing a minimum of 12 inches of CDF at the bottom of the tank excavation to seal off the upward flow of ground water and provide support for the concrete tanks. The exposed portion of the slotted steel sump casing should be wrapped with plastic prior to placement of the CDF to prevent CDF from entering the sump. We recommend placing a few inches leveling sand as necessary over the top of the CDF to provide a level surface for placing the concrete tanks.

If there is standing water at the base of excavations prior to pouring CDF, the setup of the CDF may be affected. The sump pumps discussed above should remove standing water if the flow rates into the excavation are not excessive. If flow rates are very excessive, wells may be required to control the water (Plan B below). However, if flow rates are only moderately excessive such that minor water is in the excavation, it may be possible to overexcavate about 6 inches and place clean quarry spalls in the excavation to help divert water to the sumps at the ends of the excavation. This will require a total overexcavation of 18 inches below bottom of tank (plus several inches for leveling sand, if used).

PLAN B DEWATERING

Plan B involves using one or more deep wells to remove ground water and reduce hydrostatic pressure in the vicinity of the tank excavations in the event that the sumps and CDF seal described in Plan A are not effective in controlling the ground water. Deep wells may be required to supplement Plan A methods if a zone of highly permeable coarse sand or gravel is encountered in one or more of the excavations.

The following are generic recommendations for a well design to be used by a well installer for bidding. Recommendations for a well design may vary from those presented below and will depend on site-specific soil and ground water conditions and shoring configuration. The need for and the design of deep wells should be evaluated during construction when the soil and ground water conditions are exposed. The costs of wells may also vary, depending on site-specific requirements.

WELL SPECIFICATIONS AND INSTALLATION

We recommend that Baugh contract with an experienced dewatering contractor in the event that one or more deep wells is required to control ground water during construction. At this time, we recommend drilling a 12-inch-diameter boring to a depth of approximately 40 feet below ground surface using a hollow stem auger or air rotary drilling rig. Eight-inch-diameter well casing consisting of Schedule 40 PVC or steel pipe should be installed in the boring at the completion of drilling. The upper 15 feet of the 8-inch casing should consist of blank (unslotted) pipe. The casing from 15 to 40 feet should consist of 8-inch slotted casing with the same slot widths and spacing that was specified for Plan A. The well casing from 12 to 40 feet should be filter packed with the 10-20 sand specified in Plan A. If the well is drilled outside of the sheet piles, a bentonite seal is required from the ground surface to the top of the filter pack (10 feet below ground surface), in accordance with Ecology regulations.

It may be preferable to install the deep well(s) inside the sheet piles to reduce the quantity of water pumped by the well and maximize the drawdown inside the sheet piles. If inside installation is not feasible (i.e., due to space limitations), the well(s) should be drilled as close to the outside edge of the sheet piles as possible. The number and location of the deep wells will be determined based on conditions encountered during construction. We anticipate that one or two deep wells will be sufficient for a given tank excavation.

Wells completed to depths of about 40 feet should produce approximately 50 to 100 gpm based on the sand and silty sand soil encountered in nearby borings. A submersible electric pump capable of pumping 100 gpm against 55 to 60 feet of total head should be installed in the wells.

The effective drawdown for wells installed inside the sheet pile walls would be very limited outside the perimeter of the sheet-piled excavation. Wells installed outside the sheet pile wall would have a greater effect away from the excavation, but the drawdown would probably not be sufficient to dewater manhole excavations located further than about 20 feet away.

A sketch showing construction details for the deep well described above is attached to this memorandum.

REA 85019433
BVL

DEWATERING OF UTILITIES AND MANHOLES

Based on the depth to ground water at the site, it appears that dewatering will not be required in utility excavations as deep as 7 to 8 feet if construction is accomplished during extended periods of dry weather. It is likely that utility and manhole excavations that extend to depths of about 10 feet can be dewatered using the sump design specified in Plan A. We understand that the manhole excavations will likely be open cut except for limited sheet piling in some locations. The manhole excavations can likely be dewatered using several sumps that extend approximately 5 feet below the base of the excavation. Sump specifications provided in the Plan A section of this memorandum are appropriate.

Where subgrade soils tend to become soft or disturbed during excavations for the manholes and utilities, we recommend that these soils be overexcavated and replaced with a base course of crushed rock. Typically, 6 inches to 12 inches of crushed rock is sufficient.

MISCELLANEOUS DEWATERING ISSUES

BASELINE WATER QUALITY

Ground water samples were obtained by SECOR from shallow borings at the locations of separators A5 and A6 in July 1996. The results of the analyses indicate that relatively low concentrations of petroleum hydrocarbons are present in the ground water in the vicinity of A5; trace concentrations of toluene were detected in the ground water sample from the location of A6. Based on SECOR's data, the concentrations of hydrocarbons should not exceed the operating criteria outlined in the discharge authorization letter that Baugh received from King County.

DURATION OF DEWATERING

Based on the construction schedule you have provided to us, dewatering will take place from late August to late October. The dewatering sumps and wells (if used) should be abandoned in accordance with Washington State Department of Ecology regulations at the completion of dewatering activities. Proper well abandonment involves filling the well casings with a slurry of cement and bentonite.

MONITORING

As outlined in our services agreement with Baugh dated August 9, 1996, we will observe the excavation for the oil/water separator tanks, utilities and manholes and provide consultation on an as needed basis. We recommend that GeoEngineers observe installation of the first sump to provide consultation as necessary. We also should be on site during the installation of the sumps for the manhole excavations. GeoEngineers is available to assist Baugh with dewatering water quality monitoring and other geotechnical and/or ground water issues that might arise during construction, as needed.

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